ATTACHMENT
N65540-03-Q-0370

HIGH COMPRESSION SUBMERGED MARINE FENDER SPECIFICATION

The High Compression Submerged Marine Fenders (the "Fenders") to be furnished shall be used to protect submarine and surface ships, harbor craft, wharves and piers from damage caused by vessel-to-pier or vessel-to-vessel contact. The Fenders shall be cylindrical and have an approximate 46 inch OD, 36 inch ID, a 96 inch length with a resilient polyurethane elastomer skin reinforced with nylon filament and comply with the following requirements:

General Characteristics – The Fenders shall be self-draining and constructed of non-absorbent material so that the weight of the fender will remain constant, in or out of the water. In addition, the material should be non-marking and designed not to damage the vessel structure during normal operations. The Fenders should include handling and installation lines for placement at proper depth, and be constructed with steel lifting eyes for easy retrieval from the water.

Configuration – Each Fender shall be cylindrical in shape, with an open, hollow center. Two steel lifting eyes shall be placed at each end of the Fender, 90 degrees apart, and bolted through the Fender body.

Fender Skin – The Fender skin shall be constructed of elastomer and filament reinforcing. Filament wraps should be distributed evenly throughout the inner 80 to 90% of the skin thickness. The outermost 10 to 20% of the skin thickness shall have no filament reinforcement. The skin must be applied in a continuous manner assuring adhesion between the various layers without use of adhesives that may break down with hard use.

Elastomer – The elastomer used in constructing the skin should be urethane, incorporating UV inhibitors, antioxidants and stabilizers, and have the following unreinforced properties:

Shore A. Hardness (ASTM D-2240)	: 75 to 95
Tensile Strength (ASTM D-412)	: 2500 psi (minimum)
Elongation (ultimate) (ASTM D-412)	: 300% (minimum)
Tear Strength (ASTM D-624)	: 185 lb/in (minimum)
Flex Life (Ross) (ASTM D-1052)	: 200,000 cycles (minimum)

Abrasion Resistance (NBS) (ASTM D-1630)	: 100 (minimum)

Filament Wrap – There shall be at least one wrap for every 0.116 inches (2.9 mm) of skin thickness (rounded to the nearest complete wrap). Construct each filament-reinforcing wrap of continuous filaments applied in a helical pattern, at a helix angle of 45 degrees to 60 degrees to the longitudinal axis of the Fender. A wrap shall consist of two such filament helixes of equal but opposing helix angles. The spacing between the filaments in the same helix shall be no more than 0.125 inches (3.2 mm), measured in a direction parallel to the longitudinal axis of the Fender. Each wrap shall extend along the entire longitudinal axis of the Fender and shall also encircle and encase the Fender end fittings in order to distribute impact load over the surface and to conduct the force of impact loads to the end fittings.

Filament Reinforcement – The reinforcing filaments in the outer skin shall be nylon tire cord of 2,520 denier (0.280 g/m) with the following properties:

Breaking Strength	: 53 lb
Elongation (ultimate)	: 18%

Reinforced Skin Properties—The reinforced skin, when constructed in accordance with this specification, shall exhibit the following properties when tested in accordance with the guidelines below:

Tensile Strength: When a full-thickness specimen of the skin is tested in tension, with the longitudinal direction of pull aligned with the filament direction (in one helix direction), the specimen shall have the following breaking strength:

10,000 psi (minimum)

Elongation (ultimate): In the test for Tensile Strength, the specimen shall have the following ultimate elongation at break:

16% (minimum)

Tear Strength: When a full-thickness specimen of the skin is tested in tear, with the specimen Shaped like Die C in ASTM D-624, and with the direction of pull aligned with the filament direction (in one helix direction), the specimen shall have the following tear strength:

1323 lb/in

ATTACHMENT
N65540-03-Q-0370

Dimensions: Nominal dimensions are as follows (actual dimensions may vary plus or minus 15% from stated values):

Fender Outside Diameter	46 inches
Fender Inside Diameter	36 inches
Body Length	96 inches

Applicable Standards:

American Society for Testing and Materials (ASTM):

D-412	Rubber Properties in Tension, Test Methods for
D-624	Rubber Property Tear Resistance, Test for
D-1052	Measuring Rubber Deterioration, Method for (Cut Growth using Ross Flexing Apparatus)
D-1630	Rubber Property Abrasion Resistance, Test for (NBS Abrader)
D-2240	Rubber Property Durometer Hardness, Test for